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PROBLEMS OF COMPLEX MECHANIZATION AND AUTOMATION OF PRODUCTION IN USSR

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The prerequisites now exist in the USSR for widespread development of complex mechanization, as well as for the automation of several production processes in industry and transportation.

Soviet machine building industries have made substantial gains in producing and putting into operation new, highly productive machinery, equipment, and precision instruments. The machine building industry reached its Fifth Five-Year Plan goal 8 months ahead of schedule. Growth rates in this industry exceed those of other branches of industry. Whereas gross industrial output increased more than threefold over the period 1940-1955, the total output of the machine building and metal working industry more than doubled between 1950 and 1955, and increased to 4.6 times that of the period 1940-1955. During the current 5-year plan, production of metal cutting machine tools is to increase in general by 45.5 percent, while the output of large-scale, heavy, and unique (unikal 'nyye) machine tools is to increase to 2.4 times the former level. The output of special, specialized, and aggregate machine tools is to rise by 70 percent.

The conditions necessary for effecting complex mechanization and automation of production have been created as the result of the development of precision instrument building and equipment production, as well as the production of new and improved control and measuring devices based on the most recent achievements of electronics and radio engineering, and also on the properties of hypersonic vibrations and radioactive isotopes (tracer atoms). This catagory of equipment and instruments includes: hypersonic depthometers (ekholoty); the hypersonic defectoscope developed by S. Ya. Sokolov of the Academy of Sciences USSR, by means of which quality control is maintained over concrete, porcelain insulators, and automobile tires; high speed, automatic, and electronic machines used in the solution of problems in physics, applied mathematics, mechanics, chemistry, statistics, and astronomy, as well as in the control of intricate automated production prosesses which require strict adherence to systems, and many others.

Much excellent machinery has been produced for the mechanization of heavy and time-consuming labor in various branches of the economy. This includes mechanized rolling mills with automatic control, blooming and slabbing mills and their electrical equipment, and also walking excavators with bucket capacities of 4.14 and 20.0 cubic meters. A solid agricultural machinery building base has been created, as the result of which there are now more than 1.4 million tractors in the possession of the kolkhozes, sovkhozes, and MTS, whereas in 1940 the number of these (in terms of 15 horsepower units, totaled 684,000. Over the same period, the number of grain combines increased from 182,000 to 350,000. The stock of other agricultural machinery increased at about the same rates.

The supplying of the economy with modern machinery and equipment has resulted in a considerable increase in the mechanization of labor in the fuel, metallurgical, and timber industries, and also in construction, transportation, and agriculture. In the coal industry, for example, the notching, cutting, and mining of coal and also the loading of coal aboard cars on the surface has been mechanized. By the end of 1955, sixty percent of the mines and shafts are to have undergone complex mechanization. By 1954 the mechanization of timber hauling had reached 76 percent and timber felling, 84 percent.

Nevertheless, along with these notable achievements serious shortcomings and unsolved problems still exist. Though basic processes have been mechanized, several combined, auxiliary, and preparatory processes have not been mechanized to any great extent. This fact frequently results in a reduction or total absorption of the economic efficiency due to mechanization.

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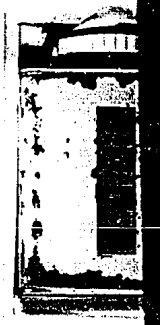

For example, in the coal industry preparatory operations have not been satisfactorily machanized; both men and machines are performing the same kind of work. Mechanization of auxiliary operations such as the driving of drainage tunnels, rigging, and other operations has lagged behind.

There are also great shortcomings in the mechanization of construction work, as the consequence of which 69 percent of the workers in this industry are even now engaged in manual labor. The mechanization of peat extraction is lagging. The result is that in summer, when agricultural operations are in full swing, more than a quarter million workers have to be shifted to peat production.

In the timber industry, although felling and hauling operations have been mechanized, other work has not. The result is that in this industry 60 percent of the workers are engaged in manual labor.

In the leather industry more than half the hide processing is done by hand, and there is a lack of loading and unloading equipment.

In the cotton procurement centers and in the industries engaged in primary processing of flax and bast fibers more than 50,000 employees work manually.

Despite the fact that tens of thousand of units of equipment were introduced into the food industries, a number of labor-consuming processes still have not been mechanized. In the meat industry, approximately half the work is performed manually; in butter and cheese plants, 53 percent; and in the separation plants, 93 percent. Fishing is not more than 70 percent mechanized, while fish processing is 32 percent mechanized.

In the cellulose and paper industry, mechanization of labor is incomplete.

In agriculture, complex mechanization has by no means been completed with respect to field operations and livestock raising. Systems of machinery designed for different regions which could ensure the complex mechanization of all agricultural operations are being developed with unjustifiable delay.

The same unevenness in the mechanization of particular processes of production exists in machine building where, as a general rule, all basic technical processes, as well as auxiliary and preparatory operations, have been mechanized. But in some instances all operations are still being performed manually. This is all the more worthy of attention, because in machine building plants approximately half the employees are engaged in auxiliary and preparatory work.

Poor mechanization of operations of the last-mentioned type and stinted development of production processes results in the situation where although enterprises and construction projects have been endowed with enormous quantities of machinery, manual labor methods are still being widely employed. As a result of the use of manual labor for auxiliary and combined operations, inadequate use is being made of the equipment in the possession of those sectors which have been mechanized. Thus, the advantage derived from the growth of worker productivity in the mechanized sectors is frequently lost because of the great expenditure of labor required in the nonmechanized sectors.

Complex mechanization means the mechanization of the entire, joint process of primary and secondary operations combined, the substitution of machinery for manual labor in all stages of production, and the achievement thereby of an over-all increase in worker productivity.

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What complex mechanization can do to increase labor productivity may be seen from the following example.

In machine building the machine time of metal processing equipment amounts, on the average, to not more than 20 to 25 percent of the total working time of equipment. The remainder of the time is spent on various preparatory and auxiliary operations which are performed mainly by hand. These include transporting procured and manufactured goods, setting them up and removing them from machine tools, changing instruments, measuring parts, and many other operations. Experience shows that mechanization of these operations makes it possible to increase over-all worker productivity by not less than 100 percent.

In a number of ministries due attention is not being given to mechanization, modern machinery is not being created, and the economic importance of complex mechanization has been underestimated.

This is the case in the coal industry. Work toward the creation of the equipment necessary for the mechanization of propping and roofing operations, as well as auxiliary operations above and below ground, is moving forward very slowly. Production of pneumatic machinery for the ventilation of gaseous horizontal tunnels is unsatisfactory. Consequently, boring, hauling, and unloading operations are performed manually. Until now no practical design has been developed for a coal combine capable of separating coal from rock. Nor is a combine available for the extraction of coal from the seams of the Moscow Basin.

The Ministry of Paper and Wood Processing Industry USSR neglects the use of machinery which is being manufactured by the peat enterprises of the Ministry of Electric Power Stations. The latter manufactures this machinery for use in its own machine building enterprises. The lack of such machinery is explained by the fact that there is no specialized branch of industry to produce the machines. There is an immediate need for specialized enterprises of this type.

Serious shortcomings likewise exist in the Ministry of Timber Industry USSR which has unduly retarded the creation of practical machines for brush cutting, although such development has been going on for years.

Some of the specific problems in the development and wider use of complex mechanization are given below.

In the mining industry complex mechanization of mines and pits for the extraction of ferrous metal ores, as well as considerable development of pit mechanization in nonferrous metallurgy, should be undertaken, so that not less than 85 percent of nonferrous ores will be extracted by this method within the next few years.

In the coal industry, the prime goal is complex mechanization of the operations involved in preparing seam faces, as well as a substantial increase in the mechanization of coal accumulation in slanted and tilted seams. It is most important to create and place in operation new machines for opening ventilation drifts, for cutting through extremely hard roch formations and formations of medium hardness, and for the extraction of coal under weak roof conditions.

Mechanization of labor-consuming subsidiary and auxiliary coal mines operations both above and below the surface must be completed as soon as possible, since most workers are engaged in this type of work. (The number of men working on the surface is about 25 percent of the number employed underground.)

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The highly productive and economical method of hydraulic coal mining placed in operation in the experimental mines of the Kuznets Basin must be extended to all the principal coal basins and underground extraction of coal must be increased. In open-pit operations it is desirable to remove the overburden by means of the transportless system, using powerful excavators and mobile draglines.

In the peat industry the following measures must be undertaken: mechanization of digging, collecting, and loading operations; development of machinery for drying peat; development of machinery for the extraction and simultaneous drying of peat with high moisture content; complex mechanization of peat bog preparation; and discovery of new and improved methods of peat extraction.

In the petroleum industry one of the most important problems involves the speeding up of experimental and operational drilling. Drilling requires the expenditure of much time and capital. It may be said without fear of overstatement that if the speed of drilling is increased and the organization of drilling operation is improved, worker productivity can be increased by at least 100 percent.

The solution of this problem requires the invention and introduction of new, efficient methods of drilling oil wells -- bitless and vibration drilling, the creation of new, mobile drilling rigs, and the mechanization of hoisting and lowering operations.

In the timber industry delays in the production of powerful and efficient machinery must be eliminated. A stable electrical base for supplying industrial timber units must be established through the use of powerful, mobile electric power stations.

It should be noted that instead of showing improvement the use of mechanical equipment in the timber industry actually lessened during the course of the Fifth Five-Year Plan. In 1954 the production goal for timber per unit of equipment was only 80 percent fulfilled. In January 1955, the timber hauled by tractor-trailer was only 38 percent of the planned amount, and that hauled by timber trucks was only 54 percent of the planned amount.

The most important tasks in the reconstruction of timber operations include: complete mechanization of all timber procurement processes; extensive use of new, more powerful machinery and devices in timber procurement, transport, loading, and unloading; and creation of dependable electric power stations operating on the basis of waste forest products.

In the postwar period the USSR cellulose and paper industry increased its production of paper and cardboard considerably. New products were produced for various industries. Greater use was made of production capacity as the result of improved technical processes.

Nevertheless, the industry is failing to meet the needs of the economy for paper products either in qualitative or quantitative terms. The level of technology in this industry is substantially below that of foreign countries, particularly the US and Canada. Responsibility for the failure to produce new types of equipment for the industry must be placed on the machine building industry, whose job it is to provide such equipment.

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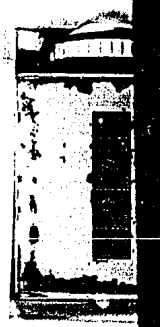

The transition of agriculture to complex mechanization depends largely on the construction of agricultural machinery for the cultivation of land and livestock raising. The machinery required for selective harvesting of grain crops must be put into production as soon as possible and existing combine designs must be improved. In particular, corn and silage combines for separate harvesting of corn ears and green stalks must be produced. The production of row crop cultivators, principally for checkrow planting, must be increased.

Machine systems must be developed for the complex mechanization of cotton production, sunflower production, and for other industrial crops, also for land improvement through lime and gypsum and fertilizer application. In developing machine systems it should be emphasized that the different conditions prevailing in various zones should be taken into account. Work in the development of loading, unloading, and transport equipment for agriculture must be speeded up.

Attention must be given to the mechanization of loading and unloading operations in the case of rail, water, ocean, and motor vehicle transportation, as well as to the access roads and warehouses of enterprises. Approximately 2 million employes are now engaged in this type of work.

Despite the fact that tens of thousands of cranes, hundreds of thousands of mobile and stationary units of transport equipment, and tens of thousands of pieces of self-loading, unloading, and stacking equipment have been placed in the possession of the national economy, a number of the heavy and labor-consuming operations involved in transportation and loading are still unmechanized. On the average, about 75 percent of the people employed in loading and unloading operations use manual methods.

In the meat and mild industry, 97 percent of the workers employed in loading and unloading operations are engaged in manual labor; in the food industry, 96 percent; in the fishing industry, 8[illegible] percent; in the construction materials industry, 86 percent; in the chemical industry, 82 percent; and in the petroleum industry, 75 percent.

In railroad loading, unloading, and warehouse operations productivity in 1954 amounted to 15-18 tons per worker, whereas in certain mechanized departments of metallurgical plants, it amounted to 250-300 tons per worker per shift.

The fundamental reason for this unsatisfactory state of affairs is poor utilization of existing equipment. On 1 January 1955, 28 ministries had some 1,400 mobile cranes, of which 723 were new. In the coal industry about 75 percent of the cranes were not being used. In the construction industry many devices were operating only 180 days during the year.

Much loading and unloading equipment is in need of repair. In the timber industry, 28 percent of the hoists (TL-1) and 24 percent of the cranes were out of order.

One reason for the serious lag in the mechanization of loading and unloading work is the lack of a scientific research, planning, and engineering institution which could be engaged in devising efficient methods of mechanization.

Of equal importance is the tendency of ministries and departments to underestimate the possibility of mechanizing this type of operation by using simple and economical methods which do not require motors and complicated mechanisms.

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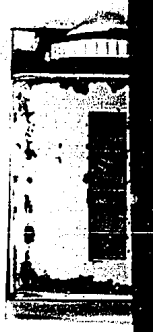

Inadequate use is being made of cheap and dependable devices such as the pneumatic equipment employed in loading cement, which is readily adaptable to other bulk commodities.

Mechanization of loading and unloading operations is seriously retarded by the relatively slow production growth of machinery designed especially for such purposes. Thus, the production of railroad cranes of 6- and 25-ton capacities, as well as 4-ton selfloaders, not only failed to increase in 1954, but actually dropped somewhat. Production of other types of loading and unloading machinery increased slightly, by from one to 4 percent.

To eliminate manual labor in these operations, to reduce costs, and to release a large number of workers for other kinds of employment, it is imperative that mechanical equipment of the needed type be produced as soon as possible and that full use be made of such equipment as is now on hand.

Automation of production based on the use of automated machinery (mashinavtomaty) and automatic machine systems which perform all the steps in the production process without the direct participation of the individual represents the highest stage in labor productivity. Under automation the role of the worker is confined to the control of mechanisms. Experience with automation in the chemical industry has shown that in 1953, as the result of the automation of the Donets Soda Plant, 56,000 additional tons of soda were obtained, while production cost was reduced by 3.6 million rubles.

In the production of bolts and nuts, automation of lines increases labor productivity fourfold to fivefold and reduces cost by 20 to 30 percent.

In leading metallurgical enterprises automated regulation of temperature, pressure, and moistrue raises the productivity of blast and open-hearth furnaces 7 to 10 percent. Automation of existing rolling mills increases productivity 15 percent.

Automation of production, like mechanization, produces best results when it is of the complex type. For example, in machine building the substitution of automatic lathes for the usual type results in an approximately fourfold increase in labor productivity. Complex mechanization of continuous flow lines, in turn, increases labor productivity at least 100 percent. In the petroleum industry complex mechanization of oil wells reduces labor requirements by 25 to 33 percent and makes it possible for a single dispatcher to control the operation of dozens of wells.

The level of science and technology which has been attained, as well as automation of specific types of production, indicates the possibility of widespread development of automation in industry. At the same time it should be noted that the proportion and scale of automated production processes in industry are still insignificant. This is especially true with respect to complex mechanizations. The basic shops of electric power stations are not undergoing satisfactory complex mechanization. Automated rolling and tube rolling mills are being introduced slowly. In the cellulose and hydrolytic industry complex automation of control and regulation of boiling and hydrolytic processes is unsatisfactory.

Automation of chemical processes is absolutely inadequate. Thus, of all the existing superphosphate plants only the Vinnitsa Plant has been partially automated. The rest show practically no automation of production processes. In the production of sulfuric acid, in general, only the control operations have been automated; in the hydrolytic plants the degree of automation ranges from 15 to 46 percent of operations as a whole.

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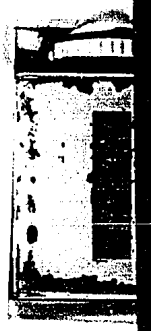

In the coal and radio engineering industry, in the machine and instrument building industry, in transport machine building, and in a number of other industries work in the direction of automation is unsatisfactory.

In the development of automation the most important factor is the development of precision equipment and instruments. Complete automation of the control and direction of chemical processes in all plants is one of the most important lines of development.

In the field of electric power it is necessary within a few years to complete the telemechanization of the primary power systems, to telemecharize all the substations included in the unified power system f the European portion of the USSR. It is also necessary to effect a transition from the telemechanization of individual electric power stations to the telemechanization of regional power nets.

The new electric substations now under construction must in general be outfitted with teledirectional equipment. All thermoelectric stations the construction of which was begun during 1955 must be equipped with complex automation devices and central control of power shops and stations as a whole.

Scientific research, planning, and engineering work must be undertaken to create a practical block of boiler turbines, fully mechanized and automated, with a capacity of about 300,000 kilowatts and steam parameters of 300 atmospheres and 650 degrees centigrade. Such a block should be put into operation within the next 5 years.

In the area of petroleum extraction automation and dispatching of all operations must be completed, and automatic discharging of paraffinic products from all pump pipes must be introduced.

In ferrous metallurgy automation of rolling and tube rolling mills must be undertaken on a wide scale; in nonferrous metallurgy, automatic control of technical mining processes, beneficiation, and metallurgical plants must be effected.

About 8 percent of all workers employed in underground mining of coal are now operating mechanisms and machines. Work in effecting remote automatic control of machinery in all basic underground and surface operations must be speeded up. In the primary coal mines centralized control and block signal systems must be introduced for underground transportation as well as complex dispatching and automatic control of mine sectors and machinery.

Automation and uninterrupted methods of operation must be introduced in the cellulose and paper industry.

The responsibility for producing the modern, highly productive equipment needed for complex mechanization and automation in all branches of the national economy rests on the machine building industry.

Along with the necessity for continuing replacement of old by new equipment and the modernization of existing equipment on a wide scale, work in the development of modern press, forge, and foundry equipment must be given priority. This is necessary because forges and foundries now constitute industrial bottlenecks.

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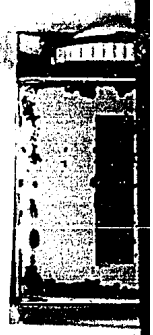

Solution of the forge and foundry problem, constituting as it does serious handicap to mechanization and automation, requires considerably greater effort on the part of scientists, designers, and technicians, as well as the partic_pation of all machine building enterprises which produce this kind of equipment. In addition, it is necessary to create and to supply the newest types of equipment to those enterprises which are now being constructed.

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